Wide Output Range Power Processing Unit for Electric Propulsion, Phase I

Completed Technology Project (2006 - 2006)

Project Introduction

Hall thrusters can be operated over a wide range of specific impulse while maintaining high efficiency. However S/C power system constraints on electric propulsion systems often force a choice of maximum power operation over a narrow range of specific impulse and thrust. Most spacecraft users would desire a continuous selection of thrust and specific impulse at maximum power when possible, but power supply systems currently do not exist with this level of functionality. To provide continuous Hall thruster adjustment, a power supply must be wide ranging in voltage, current, and power. In addition, the power supply system must be lightweight and efficient. The proposed work addresses these needs through a three-phase resonant power conversion strategy combined with novel frequency selective output-stage circuitry that will allow greater than 8:1 output voltage adjustment at power levels up to and beyond 100-kW. Three-phase resonant power converters utilize filter components with lower mass and size relative to single-phase converters, and demonstrated efficiencies are greater than 97%. Additionally, resonant converters operate at higher frequency, which results in extended stability when used in dynamic load situations imposed by Hall thrusters. The proposed Phase I program will develop a prototype power supply and demonstrate its functionality.

Anticipated Benefits

Potential NASA Commercial Applications: Non-NASA uses for the proposed idea are commercial applications for space power where low cost and high efficiency are desired. Again the same advantages apply here. The most notable being the wide utility and range. This wide range converter will reduce the number of different model types required to satisfy current and future EP thruster needs. One immediate non-NASA application is for Aerojet thrusters that are being developed for geosynchronous satellite use. Commercial non-flight applications include laboratory bench power supplies. A path to high volume sales may be achieved by using the converters refined in this SBIR for general purpose scientific equipment.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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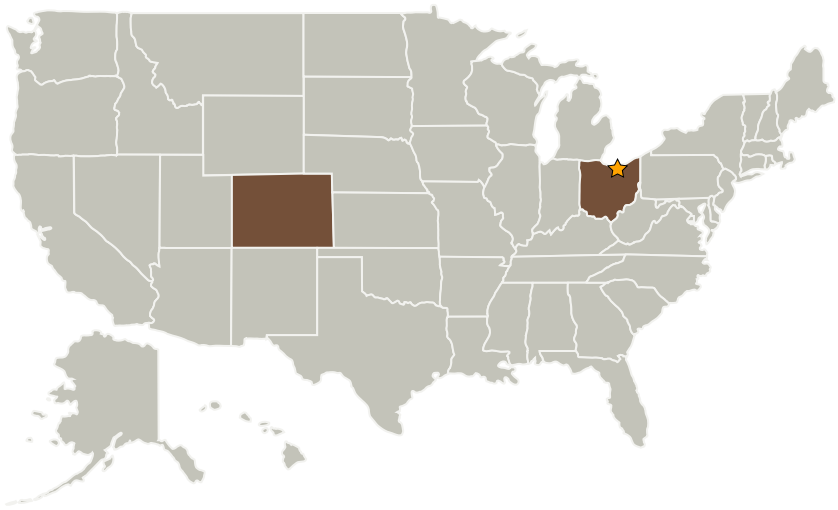
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Colorado Power Electronics, Inc.	Supporting Organization	Industry Veteran-Owned Small Business (VOSB)	Fort Collins, Colorado

Primary U.S. Work Locations	
Colorado	Ohio

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Geoffrey N Drummond

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.3 Power Management and Distribution
    - TX03.3.3 Electrical Power Conversion and Regulation